PATENT SPECIFICATION

770,062

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COMPLETE SPECIFICATION

Improvements in or relating to Prefabricated Structural Member

We, EDWARD MARTIN, PETER SIGURD PEDERSEN & PETER SIGURD PEDERSEN, JR., citizens of the United States of America, a partnership doing business as CENTRAL FARM EQUIPMENT COMPANY, of 30 North LaSalle Street, Chicago, Illinois, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates in general to a prefabricated structural member in the form of a panel or section and is particularly adapted for the construction of roofs or the like wherein the panels are joined together in a predetermined relation.

The invention is directed especially to a type of structural member which is formed from a sheet of metal and is arched longitudinally thereof with transversely extending corrugations.

The individual structural members which are curved on a predetermined radius are adapted to be secured together side by side and end to end to form what is known as a trussless roof. The completed roof is arched in a manner permitting it to be supported directly on the foundation. The absence of trusses makes it imperative that the structural member be designed and formed in such a way as to withstand maximum wind and snow loads depending, of course, upon the section of the country in which the building may be erected.

The structural members or panels as heretofore used have been corrugated longitudinally as well as transversely thereof and the transverse corrugations have been confined to the area formed by every other or alternate longitudinal corrugation. It has been found, however, that the number and depth of these transverse corrugations constitute one of the most important considerations from the standpoint of wind and snow load factors. Actual experience has proven that when the corrugations are either too deep or too shallow, or when they are either too close together thus increasing the number thereof, or too far apart thereby decreasing the number thereof, the wind and snow load allowances are definitely affected and in most cases will be decreased to a point where a roof constructed with such members may be unsafe.

It is therefore a principal object of the present invention to provide a prefabricated structural member for use in the construction of roofs, ceilings and the like, and having corrugations extending transversely of the length thereof wherein a predetermined ratio exists between the depth and width of each corrugation, thereby to increase the wind and snow load which the member is capable of withstanding without buckling.

Another object of the invention is to provide an arched or longitudinal curved structural member having corrugations extending transversely of the length thereof wherein the wind and snow load of the member, when assembled as a structure, can be predetermined and increased to a maximum by controlling the ratio between the width and maximum depth of each corrugation having regard also to the thickness of the member itself.

Still another and more specific object of the invention is to provide an arcuate structural member of elongated form having both longitudinal and transverse corrugations therein wherein the ratio of the width to the depth of each transverse corrugation is substantially 5 to 1.

A still further and specific object of the invention is to provide such a structural member wherein the depth of each transverse corrugation is substantially equal to the thickness of the member.

Other objects and advantages of the invention will become apparent upon reading the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view of a building having a roof thereon constructed of a plurality of the structural members embodying the present invention;

Fig. 2 is a perspective view of a blank sheet of material from which the structural member is fabricated;

Fig. 3 is a view of the sheet shown in Fig. 2 illustrating the next step of fabrication which includes the punching of the holes therein;

Fig. 4 illustrates the sheet of Figs. 2 and 3 after the longitudinal corrugations have been placed therein;

Fig. 5 shows the sheet in its arched or curved condition as the result of the transverse corrugations having been placed therein;

Fig. 6 is an enlarged fragmentary longitudinal sectional view taken along the plane of line 6—6 of Fig. 5 and illustrating the maximum ratio between the width and depth of the transverse corrugations;

Fig. 7 is a view similar to Figs. 6 illustrating the preferred ratio between the width and depth of the transverse corrugations, and

Fig. 8 is a view similar to Figs. 6 and 7 illustrating the minimum ratio between the width and depth of the transverse corrugations.

Referring now more particularly to the drawings, the completed building is shown generally by the numeral 1 in Fig. 1 and is illustrated as having an arched roof 2 thereon consisting of a plurality of arched members 3 secured together in end to end and side by side relation. In most instances the completed building has the roof secured in place directly to the foundation. Variations of the structure include instances where vertical side walls may be desired either on both sides or along one side of the building. The roof construction, however, is the same as that shown in Fig. 1 except that its span would not be as great.

Each end of the building may, if desired, be enclosed in any suitable manner such as by the bulkhead members 4 shown in Fig. 1.

For practical purposes and for economy in manufacture, the construction members embodying the present invention are manufactured in standard sizes. The particular member or panel shown in Figs. 2 and 3 is substantially 115 inches (240 cms) long and 33-3/4 inches 86 (cms) wide. These dimensions, however, are not intended in any way to be limiting but are merely mentioned herein as illustrative. The construction member or panel in the blank form thereof is indicated in Fig. 2 by the numeral 5. The first step in fabricating this member into usable form and that which embodies the present invention is to punch holes along each end and along each longitudinal edge thereof. An important feature of the present invention includes the spacing of the bolt holes 6 along each edge of the panel member 5. The spacing of these holes is critical for the purpose of enabling electrical conduits, plumbing fixtures and pipes, and insulating board to be fixed thereto.

For example, building codes customarily require wiring or electrical conduits to be secured or hung a minimum of 5 feet (1.5 meters) apart. Plumbing fixtures and pipes are required to be installed a minimum of 4 feet (1.2 meters) apart. Heating conduits are customarily required to be installed a minimum of 8 feet (2.4 meters) apart.

Similarly, sheets of material which may be used to form a ceiling, if desired, such as plywood, are customarily provided in sizes which are 8 feet (2.4 meters) long and 4 feet (1.2 meters) wide.

It is, therefore, important that provision be made in the construction member or panel itself to enable these standard materials and piping to be secured or hung in place without the necessity of providing additional securing means. The construction member embodying the present invention provides for the simple and expedient hanging of these standard plumbing and electrical materials without the necessity of providing any additional material and without having to drill additional holes in the member.

When the panel member is corrugated transversely thereof the result will be to curve the member lengthwise in an arc of a predetermined radius. If the holes 6 along each edge thereof have been placed therein a predetermined distance apart, then these holes will be substantially 12 inches (30.5 cms) apart between centers measured along the chord of the arc along which the member is curved. Experiments have indicated that if the holes 6 are placed substantially 12-1/2 inches apart (32 cms) between centers in the flat condition of the panel member as shown in Fig. 3, then the centers of adjacent holes will be substantially 12 inches (30.5 cms) apart after the member has been longitudinally arched due to the placing of the transverse corrugations therein.

The bolt holes 6 may, if desired, be placed apart in multiples of 12-1/2 inches (32 cms), such as 25 inches (64 cms), 37-1/2 inches (96 cms), etc. Thus, when the term "multiples of 12-1/2 inches (32 cms)" is used herein, it is intended to include either the basic distance 12-1/2 inches (32 cms) or any multiple thereof.

Since the bolt holes 6 will become located at the crest of alternate longitudinal corrugations, it will depend upon the width of these corrugations as to the spacing of the holes inwardly from each edge of the panel. For purposes of illustration, it may be stated that in one preferred form these bolt holes 6 are placed substantially 2 inches (5 cms) inwardly from each edge of the construction panel 5.

Additional bolt holes 7 are punched along each end of the member 5 preferably about 2 inches (5 cms) apart and approximately 1-1/4 inches (3.2 cms) inwardly from each end. This arrangement provides for a rigid construction for securing adjacent panel members together along their ends and sides.

The next step in fabricating the construction member of the present invention is to corrugate the member longitudinally to produce the member substantially as shown in Fig. 4. The result of this longitudinal corrugating step is to provide a central or main corrugation which is downwardly concave as indicated by the numeral 8 in Fig. 4 and the upwardly convex corrugations 9 and 10 along each edge of the member 5. It will be noted here that the bolt holes 6 are positioned at substantially the crest of each corrugation 9 and 10 so that an adjacent and identical panel member may be secured thereto by nesting the corrugation 9 along one side of the panel with the adjacent corrugation 10 of the next adjoining panel. The two panels may then be secured together by placing bolts therethrough.

The completed construction panel is shown in Fig. 5 and is shown in its arched or curved condition after the step of placing the transverse corrugations 11 in the central or main longitudinal corrugation 8 has been completed.

The construction members are preferably secured together in staggered relationship as shown in Fig. 1 by inserting bolts through the bolt holes 7 in the overlapping ends of adjacent members. These members are also secured together as above described in side by side relation by placing bolts through the bolt holes along the overlapping longitudinal edges of adjacent members. In this condition of the member, the distance between adjacent bolt holes 6 measured along the chord of the arc is about 12 inches (32 cms), so that after the building has been completed, supporting straps may be hung from these bolts to support the standard electrical and plumbing fixtures in a manner properly spaced to satisfy building code requirements.

One of the main obstacles which had to be overcome in buildings of this type was the strengthening of each member to withstand a predetermined wind and snow load without buckling. It is obvious that the deeper the transverse corrugations 11 and the closer together these corrugations are placed, the less will be the radius of curvature of the construction panel in a longitudinal direction as shown in Fig. 5. Conversely, if the corrugations are relatively shallow and far apart, the radius of curvature will be greater. The ratio of the width to the depth of these transverse corrugations 11 will also have a definite bearing upon the wind and snow load which the structure is capable of withstanding without buckling.

Numerous experiments coupled with actual experience in the field have proven that to obtain a maximum wind and snow load and eliminate the buckling factor, the depth of each transverse corrugation 11 should be approximately the same as the thickness of the material of the member, and the distance between the crests of adjacent corrugations or the width of each corrugation should be approximately five times the depth.

The fewer the corrugations, the stronger the member will be except that if the corrugations become too few, then the wind and snow load will decrease. When the ratio of the width to the depth of these transverse corrugations 11 reaches substantially 12 to 1, then the buckling factor is increased and the wind and snow load which the structure is capable of withstanding without buckling will decrease to a degree where it may be unsatisfactory and unsafe.

Conversely, when the ratio between the width and depth of the transverse corrugations 11 is approximately 2 to 1, the structure will be weakened to an extent where the resulting structure may be unsatisfactory and unsafe.

Fig. 6 illustrates on an enlarged scale the cross-sectional appearance of the transverse corrugations 11 wherein the ratio of width to depth is substantially 12 to 1. In Fig. 6 the width of a corrugation is indicated at w and the depth at d. In this figure the depth has been made equal to the thickness of the material, although this depth may also vary somewhat and yet be within an acceptable range.

In Fig. 7 the depth d of the corrugation is again equal to the thickness of the material but the width w of each transverse corrugation is substantially five times the depth, thus making the ratio 5 to 1. This has been determined to be the preferred and most acceptable corrugation ratio for the maximum wind and snow load without buckling.

Fig. 8 illustrates these transverse corrugations wherein the depth d is again equal to the thickness of the material but where the width w of each corrugation is only twice that of the depth, thus making the ratio 2 to 1. The wind and snow load which a structure having these corrugations is able to withstand again reaches a minimum and while it may be satisfactory for some parts of the country, the wind and snow load allowances are not nearly as great as where the ratio is 5 to 1.

It may be stated as a conclusion, therefore, from the experiments heretofore conducted and from actual experience, that for the maximum wind and snow load to eliminate the buckling factor, the ratio of the width to the depth of the transverse corrugations should be approximately 5 to 1.

From the foregoing it will be evident that the present invention is one which constitutes an important consideration in the construction of arched trussless roofs from prefabricated construction members from the standpoint of the wind and snow load which the structure is capable of withstanding without buckling. It is thus evident that any struc-

tural member of the general type and character disclosed herein which has the transverse corrugations thereof in a ratio of width to depth which is beyond the limits herein prescribed will be unsatisfactory and unsafe and will not in most cases conform to local building code regulations.

In addition to the foregoing, a structural member embodying the present invention has the further advantage that standard electrical and plumbing materials and fixtures as well as standard plywood sheets or insulation may be secured to the underside of a roof in a simple and expedient manner because of the critical spacing of the bolt holes as described herein.

What we claim is: —

1. A structural member adapted for use in a roof construction or the like comprising, a sheet curved in an arc lengthwise thereof and having a number of sinuous-like corrugations having their axes extending longitudinally of said sheet, and an intermediate corrugation having a number of sinuously continuous corrugations with their axes positioned transversely of said first corrugations, and characterized by the feature that the ratio of the width to the depth of said transverse corrugations is substantially 5 : 1.

2. A structural member according to claim 1, wherein a main corrugation extends longitudinally of said sheet and is disposed centrally thereof, and outer corrugations are provided along each edge of said sheet, and said transverse corrugations are located in said main corrugation.

3. A structural member according to claim 1 or 2, including bolt holes along the length of said sheet spaced inwardly from each longitudinal edge thereof and spaced apart between the centers thereof substantially in multiples of 12-1/2 inches (32 cms) along the surface of the sheet.

4. A structural member according to claim 3, wherein said bolt holes are located along the crest of each of said outer corrugations.

5. A structural member according to claim 3, wherein said bolt holes are spaced apart between the centers thereof substantially 12 inches (30.5 cms) along the chord of the arc between adjacent holes.

6. A structural member according to any of the preceding claims, wherein the maximum depth of each transverse corrugation is no greater than the thickness of said sheet.

7. A structural member according to claim 6, wherein the maximum depth of each corrugation is substantially equal to the thickness of said sheet.

8. A structural member adapted for use in a roof construction or the like constructed substantially as herein described with reference to the accompanying drawings.

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& ROLLINSON,
Chartered Patent Agents,
Agents for the Applicants.

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FIG. 1

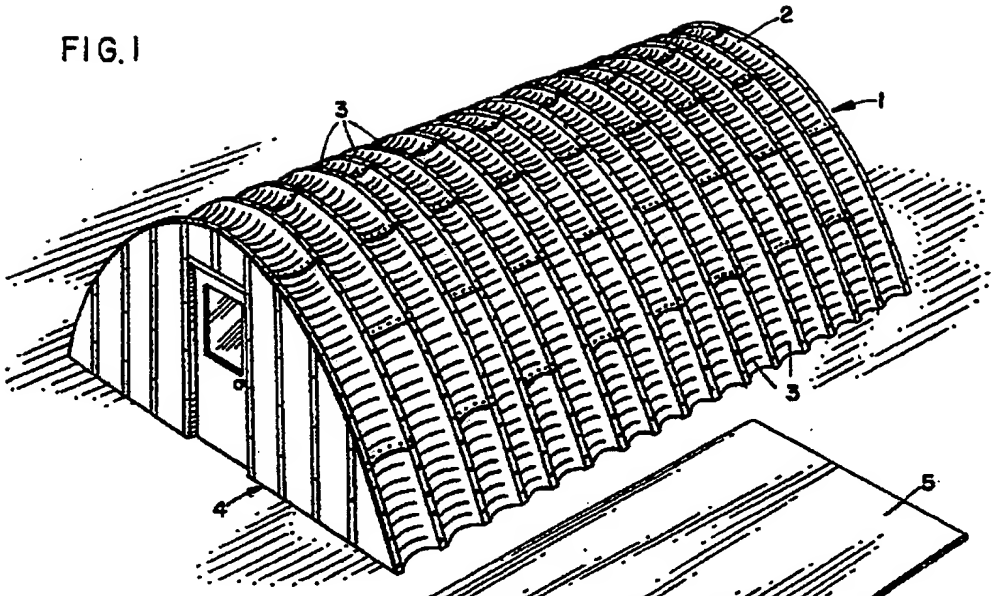


FIG. 2

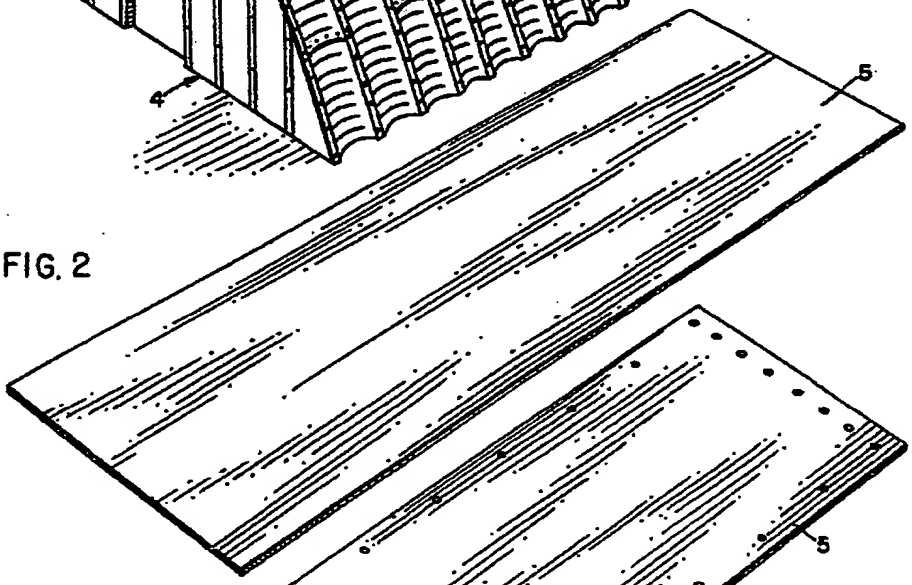
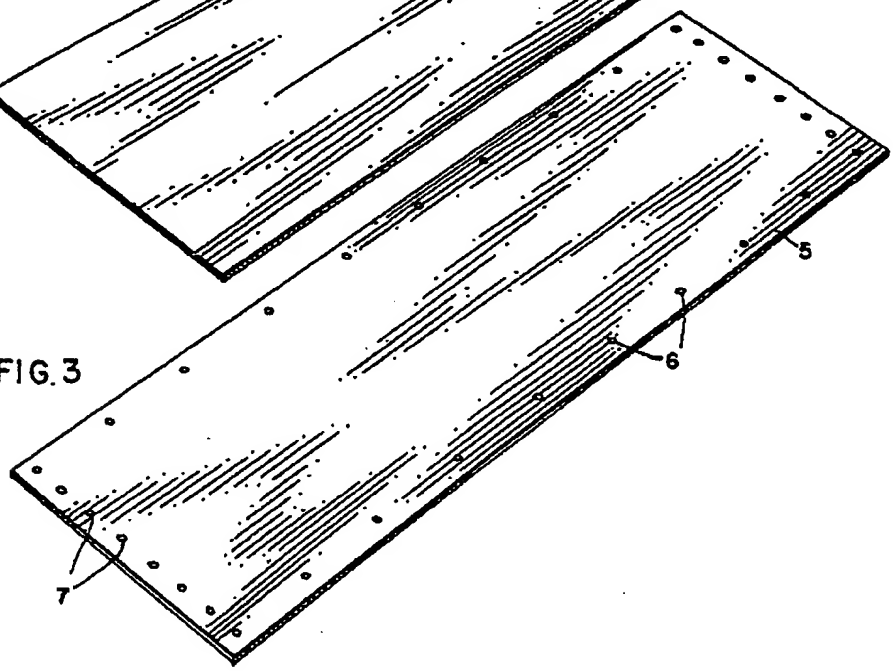


FIG. 3



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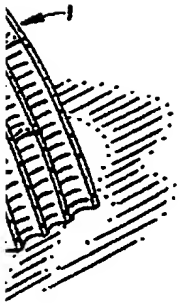

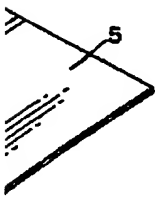

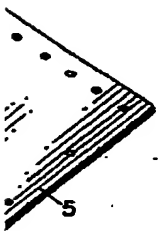

FIG. 4

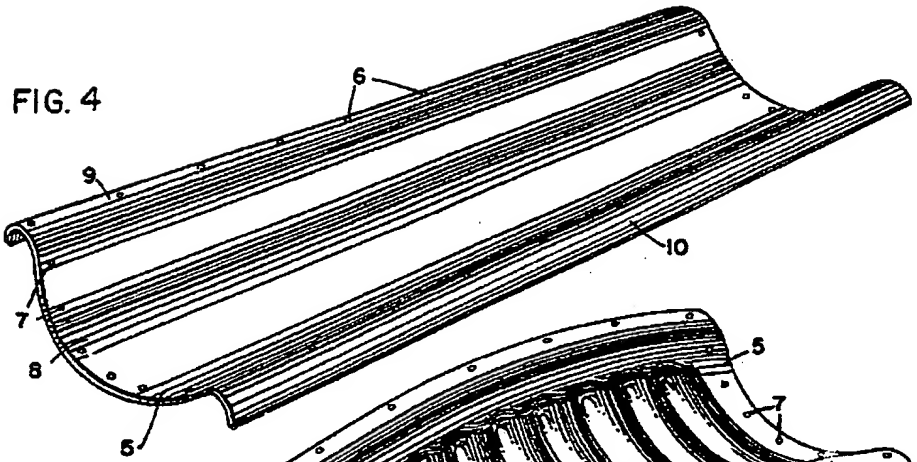

FIG. 5

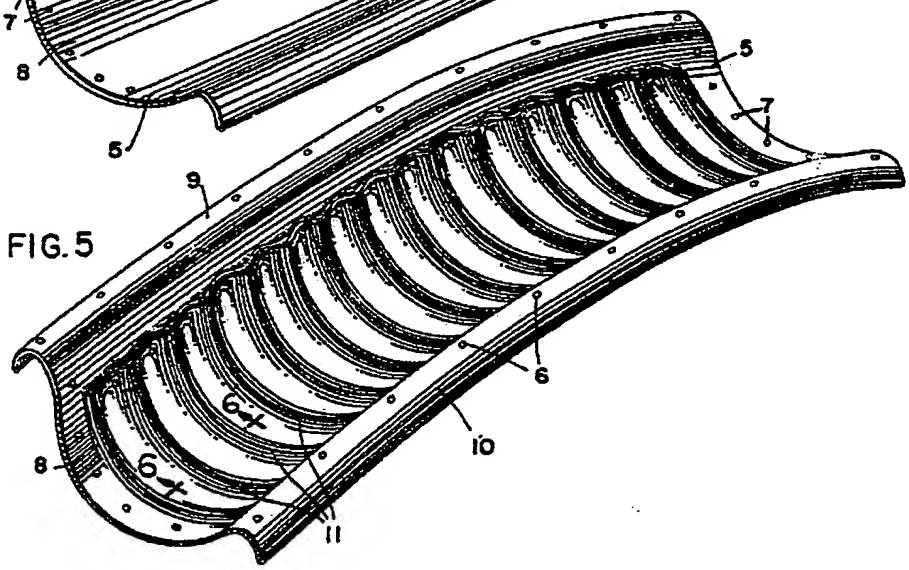

FIG. 6

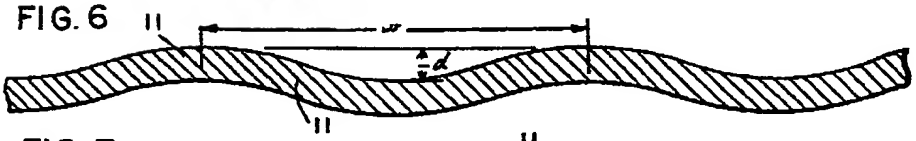

FIG. 7

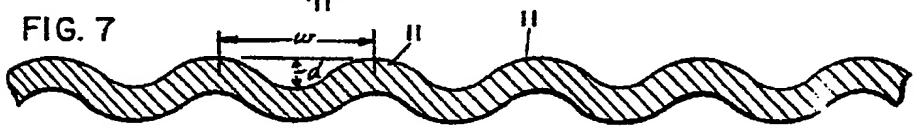

FIG. 8

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SHEETS 1 & 2

FIG. 1

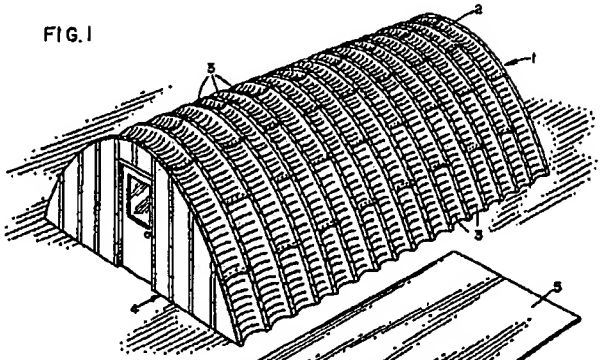

FIG. 2

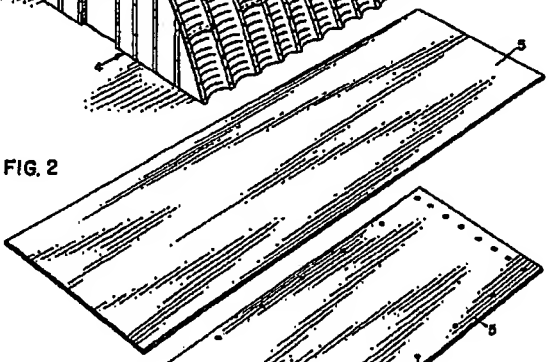

FIG. 3

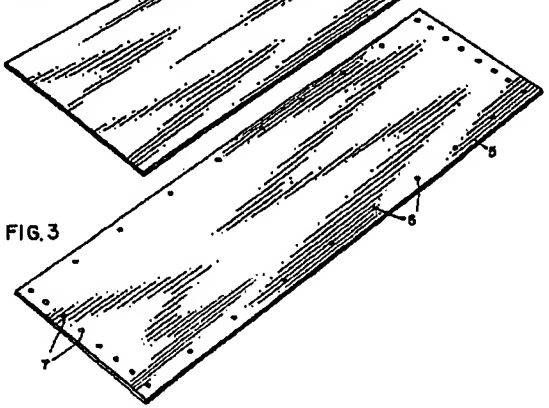

FIG. 4

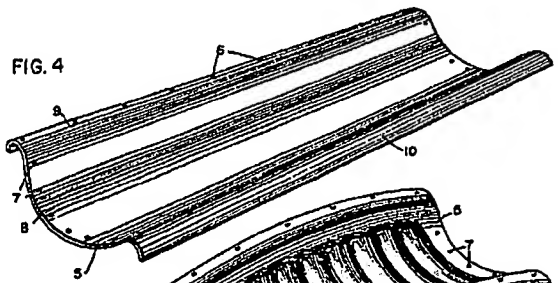

FIG. 5

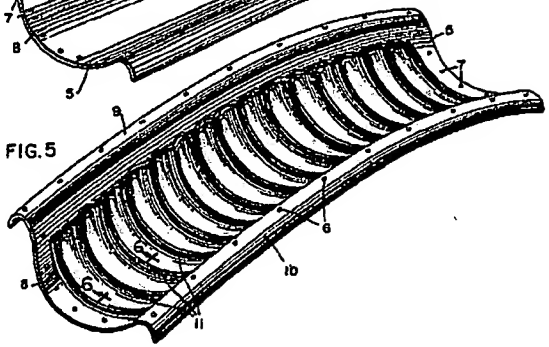

FIG. 6

FIG. 7

FIG. 8